EXHIBIT 18

Traffic Crash Reconstruction

SECOND EDITION

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or if you want to assess the sensitivity of a range of values, a spreadsheet is a valuable tool for this.

A useful procedure to follow for an actual case is to first work through the first set of calculations by hand. Then write the equations for the spreadsheet application. You should get the same answer if you use the same input values. Now you can run a range of inputs to check sensitivity. When you are asked to explain your analysis, you may find it useful to explain your hand calculations and relate those to your first iteration on the spreadsheet. Then your explanation should be easy to understand. The remaining calculations should simply show the effect of the change in variables within an expected range. This will make it easy for your interrogator to understand what you have done.

8. SOPHISTICATED RECONSTRUCTION AND SIMULATION PROGRAMS

More sophisticated application programs are often divided into two categories – reconstruction and simulation. A reconstruction program to calculate, for example, vehicle first contact velocities, takes the results of the collision such as rest positions and couples that with user inputs for parameters such as first contact positions, vehicle dimension and inertia properties, wheel lock-up values after impact, and friction coefficients. This type of analysis is often referred to as a "backward-to-forward" analysis. The main reason a simulation program is different from a reconstruction program is that rest positions are not an input to the program. The user gives the simulation program parameters such as vehicle inertia and dimension properties, braking and braking tables, and friction values. The program then calculates the vehicle motion over the defined surfaces. The simulation model may consider impacts. If impacts are modeled, the program predicts the damage and resulting vehicle travel paths, accelerations, and other data. Presumably if the user has estimated the input parameters correctly and the vehicles are damaged (in the simulation) as they were in the actual collision and the vehicles travel correctly to their rest positions, the user has a fit for the correct solution to the reconstruction problem.

The first program that was developed for collision simulation was SMAC (Simulation Model of Automobile Collisions).[25 - 29] This was developed at CALSPAN by McHenry. A second program, a reconstruction program (not simulation) developed at CALSPAN was CRASH (CALSPAN Reconstruction of Accident Speeds on the Highway).[30, 31] CRASH uses momentum to calculate first contact speeds when vehicle rest positions are known. CRASH uses crush values to calculate Δv and compares those to the momentum-based Δv calculations. The method used to calculate damage-based Δv's is given in Chapter 10. The method to calculate momentum-based Δv's is given in Chapter 9. Output from CRASH can be used as input to SMAC for a simulation. Several venders supply versions of SMAC and CRASH.[10, 13, 19, 21]

Two companies, in particular, with programs robust in their algorithms that can be used to analyze vehicle collisions are Engineering Dynamics Corporation[19] and MEA Forensic Engineers and Scientists.[14] Engineering Dynamics took several mainframe computer programs, enhanced them, and adapted them to run on personal computers. Later, they added other programs that they have developed. MEA Forensic Engineers and Scientists developed their own software and adapted the MADYMO (human simulator).

Products from MEA Forensic Engineers and Scientists include:

- PC Crash 3D
- MADYMO
- PC Crash 2D
- PC Rect

PC Crash is a rigorous 3D collision and trajectory simulation program that can analyze a variety of vehicle collisions, including vehicle with trailer(s)